

[0014] FIG. 5 illustrates the handheld electronic device surveying the scene of FIG. 4.

[0015] FIG. 6 is a flowchart representation of a method of generating a horizontal plane hypothesis in accordance with some implementations.

[0016] FIG. 7 illustrates an example height histogram based on the point cloud represented in FIG. 5.

[0017] FIG. 8 is a flowchart representation of a method of generating a vertical plane hypothesis in accordance with some implementations.

[0018] FIG. 9A illustrates an example 2D point map based on the point cloud represented in FIG. 5.

[0019] FIG. 9B illustrates an example line-space image based on the point cloud represented in FIG. 5.

[0020] In accordance with common practice the various features illustrated in the drawings may not be drawn to scale. Accordingly, the dimensions of the various features may be arbitrarily expanded or reduced for clarity. In addition, some of the drawings may not depict all of the components of a given system, method or device. Finally, like reference numerals may be used to denote like features throughout the specification and figures.

SUMMARY

[0021] Various implementations disclosed herein include devices, systems, and methods for detecting horizontal and/or vertical planes. In various implementations, a method includes obtaining a point cloud of a scene including a plurality of points in a gravity-aligned coordinate system. The method includes generating, based on the plurality of points, a height histogram indicative of a plurality of non-overlapping height ranges in the gravity-aligned coordinate system and a respective plurality of weights. The method includes generating one or more horizontal plane hypotheses based on the height histogram.

[0022] In various implementations, a method includes obtaining a point cloud of a scene including a plurality of points in a gravity-aligned coordinate system. The method includes generating, based on the plurality of points, a line-space image, each pixel of the line-space image corresponding to a two-parameter representation of a respective line at a common height in the gravity-aligned coordinate system and each pixel having a pixel value. The method includes generating one or more vertical plane hypotheses based on the one or more lines.

[0023] In accordance with some implementations, a device includes one or more processors, a non-transitory memory, and one or more programs; the one or more programs are stored in the non-transitory memory and configured to be executed by the one or more processors and the one or more programs include instructions for performing or causing performance of any of the methods described herein. In accordance with some implementations, a non-transitory computer readable storage medium has stored therein instructions, which, when executed by one or more processors of a device, cause the device to perform or cause performance of any of the methods described herein. In accordance with some implementations, a device includes: one or more processors, a non-transitory memory, and means for performing or causing performance of any of the methods described herein.

DESCRIPTION

[0024] Numerous details are described in order to provide a thorough understanding of the example implementations shown in the drawings. However, the drawings merely show some example aspects of the present disclosure and are therefore not to be considered limiting. Those of ordinary skill in the art will appreciate that other effective aspects and/or variants do not include all of the specific details described herein. Moreover, well-known systems, methods, components, devices and circuits have not been described in exhaustive detail so as not to obscure more pertinent aspects of the example implementations described herein.

[0025] In order to allow a user to place CGR objects in a CGR environment, the scene is mapped to produce a number of plane hypotheses generally describing real-world surfaces upon which CGR objects can be placed. Scene mapping can be time-consuming and/or computationally expensive. However, detecting planes of a particular geometry, such as horizontal planes or vertical planes, can be more quickly and efficiently performed.

[0026] FIG. 1 is a block diagram of an example operating environment 100 in accordance with some implementations. While pertinent features are shown, those of ordinary skill in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity and so as not to obscure more pertinent aspects of the example implementations disclosed herein. To that end, as a non-limiting example, the operating environment 100 includes a controller 110 and an HMD 120.

[0027] In some implementations, the controller 110 is configured to manage and coordinate a CGR experience for the user. In some implementations, the controller 110 includes a suitable combination of software, firmware, and/or hardware. The controller 110 is described in greater detail below with respect to FIG. 2. In some implementations, the controller 110 is a computing device that is local or remote relative to the scene 105. For example, the controller 110 is a local server located within the scene 105. In another example, the controller 110 is a remote server located outside of the scene 105 (e.g., a cloud server, central server, etc.). In some implementations, the controller 110 is communicatively coupled with the HMD 120 via one or more wired or wireless communication channels 144 (e.g., BLUETOOTH, IEEE 802.11x, IEEE 802.16x, IEEE 802.3x, etc.). In another example, the controller 110 is included within the enclosure of HMD 120.

[0028] In some implementations, the HMD 120 is configured to provide the CGR experience to the user. In some implementations, the HMD 120 includes a suitable combination of software, firmware, and/or hardware. The HMD 120 is described in greater detail below with respect to FIG. 3. In some implementations, the functionalities of the controller 110 are provided by and/or combined with the HMD 120.

[0029] In some implementations, the user wears the HMD 120 on his/her head. As such, the HMD 120 includes one or more CGR displays provided to display the CGR content. For example, in various implementations, the HMD 120 encloses the field-of-view of the user. In some implementations, the HMD 120 is replaced with a handheld device (such as a smartphone or tablet) configured to present CGR content, and rather than wearing the HMD 120 the user holds the device with a display directed towards the field-of-view of the user and a camera directed towards the scene